

STANDARDS DEVELOPMENT BRANCH OMOE
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THE
ONTARIO WATER RESOURCES
COMMISSION

CITY OF HAMILTON

WATER POLLUTION SURVEY OF SEWER OUTFALLS
AND TRIBUTARY STREAMS TO HAMILTON BAY

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1967

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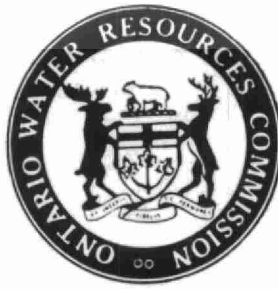
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City of Hamilton water pollution
survey of sewer outfalls and
tributary streams to Hamilton
Bay.

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CITY OF HAMILTON

WATER POLLUTION SURVEY OF SEWER OUTALLS
AND TRIBUTARY STREAMS TO HAMILTON BAY

DISTRICT ENGINEERS BRANCH

DIVISION OF SANITARY ENGINEERING

ONTARIO WATER RESOURCES COMMISSION

1967

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INTRODUCTION

Over the past decade Hamilton Bay has been the subject of study by various municipal and provincial agencies. Further, it has been stated that "emissions from the bay constitute the major source of contamination in western Lake Ontario" (OWRC-Biology Report, 1966). The bulk of this contamination is both industrial and domestic in origin, entering the bay and incoming streams through a complexity of private and municipally-owned sewer pipes. Additional liquid pollution, in a very concentrated form, is emitted from local refuse disposal sites where it is received by adjacent streams for ultimate discharge into the bay. The combined effects of these discharges on the water quality of Hamilton Bay has been well documented in previous Commission reports. However, as pollution abatement programmes are implemented, the interpretation of associated changes in water quality requires the continued study and evaluation of the bay. In addition, the effectiveness of newly installed pollution control facilities must also be periodically evaluated.

In 1964 the Ontario Water Resources Commission published a report describing industrial wastes being discharged to Hamilton Bay by waterfront industries (OWRC-Industrial Wastes Report, 1964). In some cases the wastes were being discharged through private sewers directly to the bay while, in other cases,

connection had been made to municipal storm sewer outfall pipes. The extent to which sanitary pollutants are being carried in these outfall pipes is the subject of this report. The area of study has been expanded to include Redhill Creek and sections of Ancaster and Chedoke Creeks where storm outfalls or refuse disposal sites may be influencing the quality of the receiving stream.

Separate pollution reports of the type herein presented have been previously prepared on adjacent areas to the east and west of the City of Hamilton.

SUMMARY

This report assesses the extent to which pollutant material is gaining access to Hamilton Bay and tributary streams via existing City of Hamilton facilities. Outfall sewers, streams and the bay itself were sampled and visual observations recorded in the assessment. The study was performed in relatively dry weather and, in cases where storm sewer outfalls were observed to be carrying flows, the relative amounts of wastes were calculated. Related shoreline data is presented on the immediate area of influence for all bayfront outfall sewers.

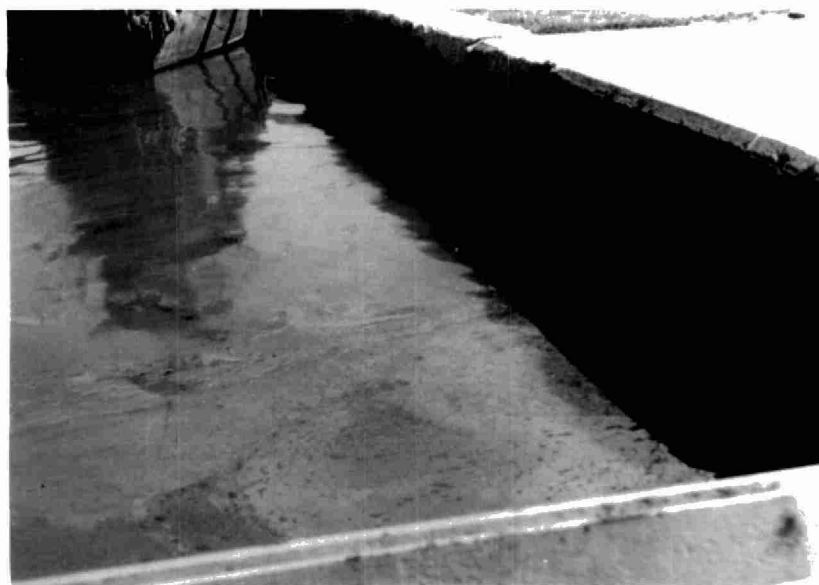
The report concludes that polluting materials from industrial and domestic sources are being discharged in significant quantities via the City of Hamilton storm sewer system into Hamilton Bay. In addition, pollutants are gaining access to receiving streams from the municipal refuse disposal sites.

It is recommended that the City of Hamilton should investigate the sanitary and storm sewer collection systems to establish a programme which will reduce to acceptable levels the amounts of pollutants presently gaining access to Hamilton Bay and tributary streams. Further, the City of Hamilton should continue to investigate means by which water pollution from the refuse disposal areas can be eliminated.

GENERAL

The early sewers in the city were constructed to carry combined storm water and sanitary sewage for discharge directly to Hamilton Bay. In recent years, however, the economics of sewage treatment have dictated the installation of separate sewers for each and the containment of sanitary wastes for direction to sewage treatment facilities. In many of the older areas of town, the combined sewer system still exists and, during periods of heavy rainfall, carries large volumes of diluted wastes, taxing not only the capacity of the treatment works but also of the sewage collector system. In order to protect the City of Hamilton sewage collector system and treatment works, major trunk sewers and pumping facilities were equipped with overflow by-pass pipes. Under heavy flow conditions these by-passes were intended to divert excessive amounts of untreated sewage directly to the bay. Normally, the by-passes would be in use only during extremely heavy rainfall periods. Under normal operating conditions a sanitary sewer system should be adequately sized to carry all wastes to the sewage treatment plant.

In Hamilton a large number of storm sewer outfall pipes which discharge to the bay are used as receivers for by-passed sewage. In particular, the east-west Burlington Street sanitary trunk sewer has many such connections along its



TYPICAL STORM SEWER OUTFALLS

THESE TWO PICTURES SHOW PARTIALLY SUBMERGED STORM OUTFALL SEWER TYPIFYING THE TYPES DISCHARGING TO HAMILTON BAY. DIFFICULTIES IN FLOW MEASUREMENT ARE OBVIOUS.

length. These municipally-owned outfall pipes are numbered and shown in Appendix 1, Map no.1. Pipes numbered 3 and 17 are the sewage pumping station high-level overflow and the sewage treatment plant outfall respectively. The remaining outfalls are storm sewers which should, under normal conditions, be dry or carrying water which is free of human or industrial pollutants. In order to assess the storm sewer contents, the chemical quality was examined, the results of which have been correlated with similar analyses on bay water at the various pipe outlets. Numerous private industrial outfall sewers, although not shown on the map, also discharge at various unmarked locations along the shoreline.

In addition to the City of Hamilton waterfront outfall sewers, Map no.1 also shows the bayfront shoreline grid. The grid system represents a concentration of sampling points which form part of the overall grid pattern established on Hamilton Bay. Shown also on Map no.1 are two Chedoke Creek sampling points in the vicinity of the west end refuse disposal area. Sampling points were also located further upstream on Chedoke and Ancaster Creeks.

Appendix 1, Map no.2, shows the drainage basin of Redhill Creek from its extremities in the Townships of Glanford, Saltfleet and Binbrook to its confluence with the most easterly

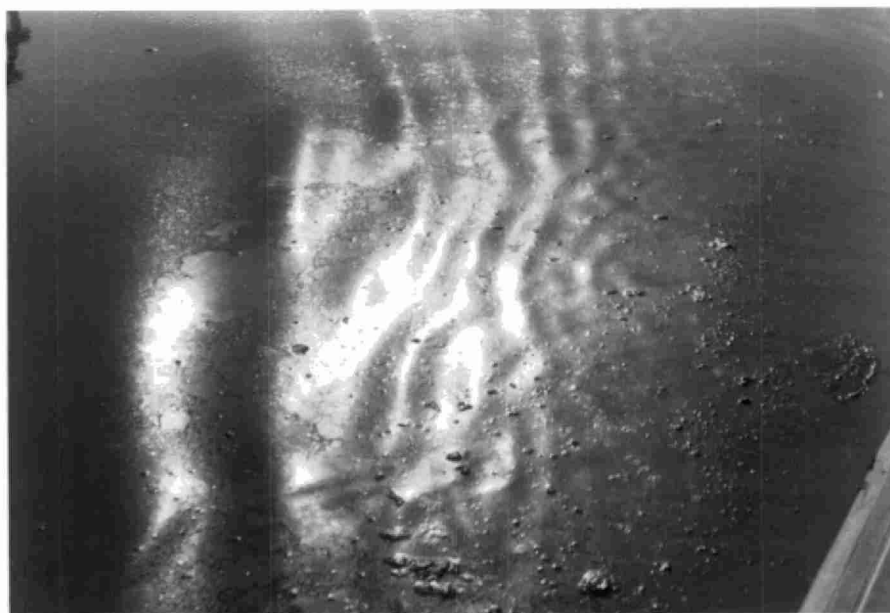
part of Hamilton Bay. The Hamilton sewage treatment plant discharge, shown as no.17, is located near the foot of Woodward Avenue approximately 0.1 miles upstream from the mouth of Redhill Creek. Permanent Commission monitoring stations, numbered 38 and 42, are located just below the treatment plant outfall and at the foot of Greenhill Avenue respectively. Average data is used from these locations.

The upper Ottawa refuse disposal site is shown on the map to be located north-east of the intersection of Upper Ottawa Street and Stone Church Road. Sampling has been carried out above, within, adjacent to, and downstream from the refuse site. Additional samples were collected from various locations along the length of Redhill Creek and from storm sewers discharging into the creek at Barton Street, King Street, and Queenston Road. All sample points are numbered with a complete list presented in Appendix 11. It is the purpose of this section of the study to indicate possible sources of pollution entering Redhill Creek.

SURVEY PROCEDURES

Waterfront Outfalls

No attempt was made in the waterfront survey to produce exact numbers of pounds of polluting material being discharged to the bay. The intent of the survey was to determine the relative quantities of pollution, if any, in the municipal



UNIDENTIFIED SLIP AT EAST END OF PAD-200

WATER COATED WITH BLACK OIL AND FAECAL SOLIDS. A TYPICAL
OBSERVATION IN EAST END BOAT SLIPS.



EAST END SHORELINE

OIL ACCUMULATIONS SHOWN ALONG SHORELINE, BUBBLES AND
FOUL ODOURS INDICATE SEPTIC CONDITIONS. THERMAL EFFECTS
OF INDUSTRIAL DISCHARGE CREATE STEAM ON SURFACE.

sewer outfall pipes. Pollutational quantities would, of course, vary with rainfall conditions and the accuracy of flow measurement in the pipes, and would require a survey of much longer duration. It is hoped that the results of this OWRC survey will instigate a comprehensive investigation and report by the City of Hamilton on the problem areas.

An initial visual survey of all sewers was carried out prior to the one day sampling programme. In some instances it was not possible to assess the contents of a particular pipe due to physical limitations. As a result, it was determined at that time, in dry weather conditions, that the only storm sewers with observable flows which could be monitored were those numbered 1, 5, 6, 8, 11, 14, 15, and 16. Since many of the pipes had submerged outlets, observations had to be carried out at upstream manholes. These became the sample point locations which are shown as such on Map no.1. All samples were analysed, using standard methods, at the Ontario Water Resources Commission Laboratories.

A few days later composite sampling of the aforementioned pipe flows was carried out in intermittent very light rain. In order to evaluate the quantities of organic pollutants which might be present it was necessary to estimate the flow volumes. These were determined by visual velocity and cross-sectional area

measurements at pre-determined times during the composite sampling programme. Aliquot sizing was proportional to flow volume.

The bay front grid survey was carried out from a Commission vessel, employing standard techniques for surface, depth and bottom sampling. Samples were obtained as closely as possible to the sewer discharge points.

Chedoke and Ancaster Creeks

Grab samples were obtained from various locations along Chedoke Creek and sewer outfalls to both Chedoke and Ancaster Creeks. In all cases visual observations were recorded.

Redhill Creek

Composite samples were obtained from storm drains on Barton and King Streets and Queenston Road, all with discharge to Redhill Creek. Composite sampling data from the Hamilton sewage treatment plant has been averaged for 1967 to provide an estimate of the quantities of organic matter being discharged from this source. Average data from the two monitoring stations is also presented. Data from the monitoring station below the sewage treatment plant outfall covers the period from October 1966 to September 1967. The second monitoring point at Greenhill Road was established in July 1967 with data averaged through September 1967.



JAMES ST. STORM OUTFALL

INDUSTRIAL AND DOMESTIC
WASTES PRESENT WITH FLOAT-
ING FAECAL MATTER IN EVIDENCE.



JAMES STREET SLIP

PICTURE SHOWS OIL ON WATER SURFACE AND SMALL
AMOUNTS OF FLOATING HUMAN EXCREMENT.

PRESENTATION OF RESULTS

Although a very light intermittent rain fell during the waterfront survey, flows in all eight storm outfalls under study showed only minor fluctuations. The samples obtained were analysed for the common water pollution indicators, namely Biochemical Oxygen Demand (5-day BOD) and suspended solids, in addition to blanket analyses for industrial contaminants. Industrial wastes, in the storm outfalls which were sampled, would originate from industries located south of Burlington Street. The complete chemical results are presented in Appendix III. The location numbers shown may be identified by reference to Map no.1 and Appendix II. Detailed chemical analyses from the bayfront grid survey are not presented in this report. However, pertinent data and visual observations are included as Appendix IV. The location numbers referred to in this appendix relate to the shoreline grid system shown on Map no.1. A full report on this aspect will be prepared by our Water Quality Surveys Branch at a future date. This will contain the results of a series of Hamilton Bay sampling surveys.

Chemical and bacteriological results of sampling on Redhill, Ancaster and Chedoke Creeks are included in Appendix III. With the exception of Ancaster and Upper Chedoke Creek sampling points, location numbers may be identified by reference

to Map nos. 1 and 2 respectively. Where a number of separate samples were obtained from the same location, the values have been averaged and are indicated as such.

Table no.1 shows estimated daily flows and total daily volumes of organic pollutants being discharged to Hamilton Bay at the specified waterfront outfall locations under study. Chemical contaminants of industrial origin which are mixed with the domestic sewage are also listed where found to be present. Average 1967 data on the sewage treatment plant discharge at Woodward Avenue is also presented.

DISCUSSION

Waterfront Discharges

The eight storm sewers under study were found to be discharging varying degrees of pollution consisting of domestic and industrial wastes. One of the major measures of organic pollution in use today is the test called the Biochemical Oxygen Demand, (5-day BOD) which is associated with organic wastes. By reference to Appendix III-Part A, it is shown that the 5-day BOD levels are much higher than the 1 to 2 ppm maximum levels normally found in unpolluted waters. The presence of anionic detergents together with the high 5-day BOD levels clearly show the presence of sanitary sewage. The heavy metals and phenols without doubt indicate that industrial wastes are also present in varying degrees in all waterfront samples.

TABLE NO. 1

ORGANIC AND CHEMICAL POLLUTANTS IN BAYFRONT DISCHARGE SEWERS

<u>LOCATION</u>	<u>STREET NAME</u>	<u>TOTAL LBS., BOD/DAY</u>	<u>EST. FLOW IGPD</u>	<u>CHEMICAL CONSTITUENTS PRESENT</u>
1	QUEEN STREET	183	831,000	CHROMIUM, COPPER, LEAD, IRON, DETERGENT COMPONENTS, PHENOLS
5	JAMES STREET	570	432,000	CHROMIUM, COPPER, LEAD, IRON, DETERGENT COMPONENTS, PHENOLS
6	CATHARINE STREET	275	306,000	CHROMIUM, COPPER, LEAD, IRON, DETERGENT COMPONENTS, PHENOLS, CYANIDE
8	WELLINGTON STREET	1108	2,903,000	CHROMIUM, COPPER, LEAD, IRON, DETERGENT COMPONENTS, PHENOLS, CYANIDE
11	BIRCH AVENUE	685	1,850,000	CHROMIUM, ZINC, COPPER, LEAD, IRON, PHENOLS
14	KENILWORTH AVENUE	1005	1,648,000	CHROMIUM, ZINC, COPPER, LEAD, IRON, PHENOLS
15	STRATHEARNE AVENUE	6230	9,734,000	ZINC, COPPER, NICKEL, CYANIDE, IRON, PHENOLS
16	PARKDALE AVENUE	39	447,000	CHROMIUM, ZINC, COPPER, NICKEL, LEAD, CADMIUM, IRON, PHENOLS
17	SEWAGE TREATMENT PLANT OUTFALL (1967 AVERAGE FIGURES)	17,689	36,100,000	(NOT AVAILABLE)



HAMILTON RAY NEAR OTTAWA ST.

WATER WAS DISCOLOURED YELLOW-BROWN. FLOATING OIL ALSO WAS PRESENT.

OTTAWA STREET SLIP

EXTENSIVE DEPOSITS
OF BLACK OIL AND
SEPTIC SLUDGE WERE
STIRRED UP IN WAKE
OF BOAT.



With a knowledge of flows and the concentration of 5-day BOD present in a discharge, it is possible to establish figures in pounds or tons of organic matter being emitted each day from a particular sewer. Table no.1 presents this data while Table no.2 goes one step further with a graphical presentation and population equivalent rating for the eight storm sewers under study.







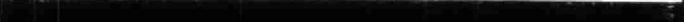


<u>STREET</u>	<u>POLLUTION IN STORM-WATER OUTFALLS</u>	<u>B.O.D.5 LBS/DAY</u>	<u>POPULATION EQUIVALENT</u>
QUEEN ST.		183	1,100
JAMES ST.		570	3,400
CATHERINE ST.		275	1,600
WELLINGTON ST.		1,108	6,600
BIRCH AVE.		685	4,100
KENILWORTH AVE.		1,005	6,000
STRATHEARNE AVE.		(SEE BELOW)	
STRATHEARNE AVE.		6,230	37,000
PARKDALE AVE.		39	200

TABLE NO.2

QUANTITATIVE COMPARISON OF ORGANIC POLLUTION
IN GRAPHICAL FORM

By reference to these tables it can be seen that the Strathearne Street sewer was the major contributor of pollution during the period of study. Over three tons of organic matter,

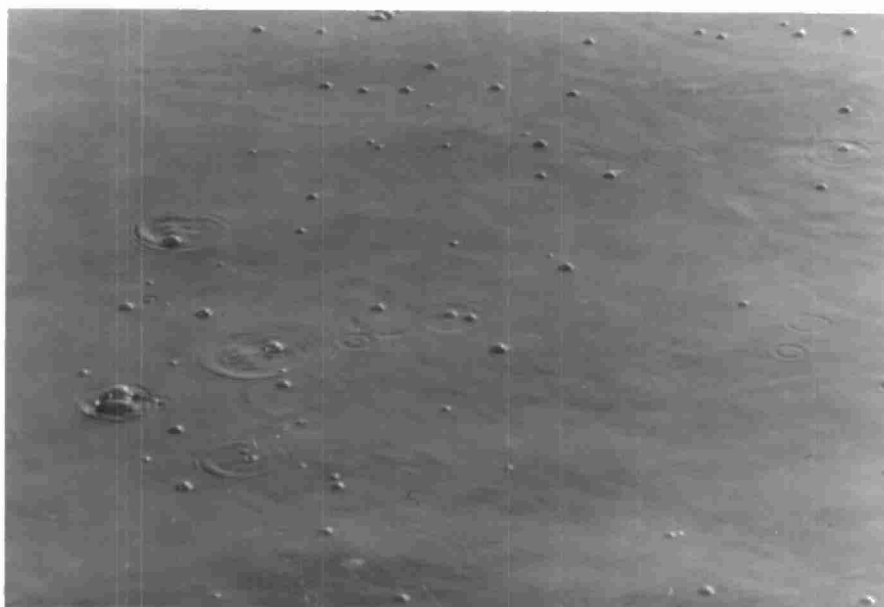
or the equivalent of the daily organic contribution of some 37,000 persons, is estimated to have been entering the bay from this source on the day of sampling. This and other organic discharge figures would, in all probability, be proportionally larger during periods of more intensive rainfall. For purposes of comparison during 1967 the partially treated sewage being discharged from the primary-type sewage treatment plant averaged the equivalent organic contributions of slightly over 100,000 persons daily. Sewage contributions of 6,660 and 6,000 persons have been estimated as the equivalent discharges from the Wellington Street and Kenilworth Avenue storm sewers respectively. The presence of this pollution indicates that either the by-pass facilities are not properly constructed, the collector system is of inadequate size to contain normal flows, or that there are direct sanitary and industrial connections to the storm sewers.

Flows were evident only in eight of the waterfront storm sewers which were studied. There was extensive evidence that most of the other storm sewers were discharging domestic and industrial wastes periodically. Appendix IV includes data and observations arising out of the waterfront survey and sampling of the bay in the vicinity of all storm sewer outfalls. Table no.3 summarizes this data and confirms that pollution is entering the bay through all 15 municipal storm outfalls.



WELLINGTON ST. STORM OUTFALL

EXTREMELY LARGE AMOUNTS OF DOMESTIC AND INDUSTRIAL POLLUTION ENTER HAMILTON BAY FROM THIS SOURCE. THE RECEIVING WATERS HAVE BECOME SEVERELY CONTAMINATED AND A GREAT DEAL OF HUMAN EXCREMENT WAS VISIBLE.



WELLINGTON ST. SLIP

IN THIS CLOSE-UP OF THE WATER SURFACE, FLOATING SOLIDS ARE VISIBLE. BUBBLES OF SOUR GAS CAN BE SEEN RISING FROM THE ACCUMULATIONS OF SEPTIC SLUDGE ON THE BOTTOM OF THE SLIP.

Where high coliform counts are reported, then associated faecal or sanitary sewage contamination is indicated. Contamination by industrial wastes is indicated by evaluation of several chemical parameters, data for which is given in Appendix IV. Over long periods of time, sanitary wastes may build up on the bottom of the bay. Table no.3 contains comments on this aspect as well as describing observable conditions such as colour, gas bubbles, bad odours, oil on the water surface, or the presence of sanitary wastes along the shoreline or floating in the vicinity of the individual outfalls.

It is obvious from the analytical data that pollution from industrial and domestic sources is being discharged to Hamilton Bay in significant quantities through waterfront storm sewer outfalls. Such pollutants should not be present during periods of dry weather as was experienced during the survey. Shoreline pollution was indicated by high bacterial counts and various observations of faecal solids and industrial contaminants. A long term build-up of sanitary wastes on the bottom of the bay was evident opposite the discharge points at Ferguson, Wellington, Hillyard, and Ottawa Streets. Severe pollution from faecal wastes was apparent in the vicinity of Hess, Caroline, Wellington and Hillyard Streets, and Birch, Gage, Kenilworth and Strathearne Avenues. Extensive industrial pollution was apparent at Wellington Street, Ottawa Street, Birch Avenue, and Gage Avenue.

BOTTOM OF BIRCH AVE.

SHORELINE OF SHERMAN INLET SHOWING
FLOATING OIL AND DEBRIS. OILY
SLUDGE HAS ACCUMULATED AT THE BASE
OF THE EMBANKMENT.



BIRCH AVENUE SLIP

OIL AND FAECAL SOLIDS WERE FLOATING ON THE
WATER. EXTENSIVE SANITARY AND INDUSTRIAL
POLLUTION WERE IN EVIDENCE.

SUMMARY OF BAY SAMPLING RESULTS

<u>LOC. NO.</u>	<u>STREET NAME</u>	<u>COLIFORMS PER 100 ML.</u>	<u>% VOLATILES ON BOTTOM</u>	<u>COMMENT</u>
* 1	QUEEN	> 500,000	< 11%	FAECAL WASTES PRESENT. NO APPRECIABLE LONG TERM BUILD-UP ON BOTTOM OF BAY.
2	HESS & CAROLINE	> 500,000	13%	OIL ON SURFACE AND BOTTOM. BAD ODOURS. HUMAN EXCREMENT VISIBLE. NO APPRECIABLE SETTLING.
4	SIMCOE	> 5,000,000	4%	INDUSTRIAL AND FAECAL POLLUTION. NO APPRECIABLE LONG TERM BUILD-UP ON BOTTOM.
* 5	JAMES	> 190,000	LOW	INDUSTRIAL AND FAECAL POLLUTION. HUMAN EXCREMENT VISIBLE. NO BUILD-UP ON BOTTOM.
* 6	CATHARINE	1,600,000	< 5%	NO APPARENT LONG TERM BUILD-UP ON BOTTOM. NO VISIBLE WASTES. FAECAL POLLUTION INDICATED.
7	FERGUSON	300,000	54%	INDUSTRIAL AND FAECAL POLLUTION. BUILD-UP OF FAECAL SOLIDS ON BOTTOM.
* 8	WELLINGTON	> 5,000,000	32%	BAD ODOURS. HUMAN EXCREMENT VISIBLE. SEVERE POLLUTION FROM INDUSTRIAL AND DOMESTIC SOURCES. BUILD-UP OF FAECAL SOLIDS ON BOTTOM.
9	WENTWORTH	> 50,000	7%	NO SETTLING PROBLEM. SOME INDUSTRIAL AND DOMESTIC POLLUTION EVIDENT.
10	HILLYARD	> 72,000	38%	BAD ODOURS. FAECAL WASTES AND OIL PRESENT. BUILD-UP OF FAECAL SOLIDS ON BOTTOM. INDUSTRIAL POLLUTION.
*11	BIRCH	> 5,000,000	16%	LARGE AMOUNTS OF OIL. INDUSTRIAL AND FAECAL POLLUTION. NO LONG TERM SETTLING PROBLEM.
12	GAGE	410,000	1%	EXTENSIVE FAECAL AND SEVERE INDUSTRIAL POLLUTION. NO LONG TERM SETTLING.
13	OTTAWA	250,000	> 20%	BLACK COLOUR WITH SUSPENDED SOLIDS AND EXTENSIVE OIL. FAECAL POLLUTION. LONG TERM SETTLING OF FAECAL SOLIDS.
*14	KENILWORTH	> 5,000,000	-----	HUMAN EXCREMENT VISIBLE. FOUL ODOURS. GAS BUBBLES. SEVERE FAECAL POLLUTION WITH SOME INDUSTRIAL.
*15	STRATHEARNE	> 5,000,000	1%	HEAVY SCUM. GAS BUBBLES. HUMAN EXCREMENT VISIBLE. SEVERE FAECAL AND INDUSTRIAL POLLUTION. HEAVY ALGAL GROWTH. NO LONG TERM SETTLING.
*16	PARKDALE	300,000	-----	HUMAN EXCREMENT VISIBLE. HEAVY ALGAL GROWTH. FAECAL AND INDUSTRIAL POLLUTION.

NOTE: * SEE COMPARATIVE RESULTS FROM STORM SEWER SAMPLING

> MEANS "GREATER THAN" < MEANS "LESS THAN"



STERLING ST. NEAR FORSYTHE AVENUE

STORM SEWER DISCHARGE INTO CREEK BED SHOWING THE REMAINS
OF HUMAN EXCREMENT AND TOILET TISSUE.



KENILWORTH AVENUE STORM OUTFALL

DISCOLOURATION AND FAECAL SOLIDS PRESENT. SLIP SHOWS
EVIDENCE OF EXTREME DOMESTIC AND INDUSTRIAL POLLUTION.
GAS BUBBLES AND FOUL ODOURS WERE INTENSE.

West End Sample Locations

A number of stream and sewer sample points were established in the west end of Hamilton a list of which is included as Appendix II. Where discharges were evident grab samples were obtained and visual observations recorded. Sample analyses are shown in Appendix III, Part A.

The Sterling Street storm sewer (no.32), although not flowing during the inspection, showed visual evidence of a recent sanitary sewage discharge into a local ravine. The drain outlet to Ancaster Creek (no.53) at Highway 8 showed a high 5-day BOD and the presence of phenols indicating pollution of industrial or domestic source. It is understood that the Main Street sewer has an overflow weir at Ewen Road with an outfall into Ancaster Creek below West Park Avenue (no.31). At the time of inspection, during relatively dry weather, although the Main Street sewer was not by-passing, it was flowing almost full indicating that by-passing would probably take place quite frequently with any amount of rainfall.

Chedoke Creek and contributory drains were inspected and sampled at several locations (nos. 55-59 incl.). The most significant factor is the presence of industrial wastes in samples no. 57 and 59 which is evidenced by the low pH value, and the presence of certain chemical indicators such as the extremely

REDHILL CREEK AT ALBION
ROAD BRIDGE

ALGAE AND STREAM DIS-
COLOURATION IN EVIDENCE.



REDHILL CREEK WEST OF ALBION
ROAD BRIDGE

LOCATED DOWNSTREAM FROM UPPER
OTTAWA REFUSE SITE WITH DIS-
COLOURATION OF STREAM BANKS
NEAR WATER SURFACE CAUSED
BY LEACHATE.

high phenolic concentration (30,000 ppb) in sample no.59. Anionic detergents show that domestic wastes are also present to some extent. In addition, the 100 ppm 5-day BOD being discharged from the west end refuse site drain (no.56) represents a further source of pollution entering Chedoke Creek. Both Ancaster and Chedoke Creeks enter Coote's Paradise and ultimately flow into Hamilton Bay. Other sewers listed in Appendix II and not discussed in this report either were not inspected or were not suspected of carrying waste pollutants.

Redhill Creek

The laboratory analyses of samples taken along Redhill Creek are summarized in Appendix III, Part B. Storm sewers on Barton Street, Queenston Road and King Street (nos. 18-22) all were found to be carrying organic pollutants probably of a domestic nature. The pollutants in the King Street sewer may be due to by-passed sewage. However, the other sewers have no known by-pass connections and should not be carrying pollutants. All other samples were obtained directly from Redhill Creek and show the influence of the sewage discharges.

By reference to the analytical data and Map no.2, the influence of the Upper Ottawa refuse disposal site and the discharge from the sewage treatment plant can be seen. As Redhill Creek passes alongside the refuse disposal site it picks up



PARKDALE AVE. STORM OUTFALL

TYPICAL PARTIALLY SUBMERGED OUTFALL. BLACK OIL
AND FAECAL WASTES PRESENT ALONG EDGES OF DITCH.



FOOT OF GREENHILL AVENUE

SEWER BY-PASS TO REDHILL CREEK AT ALBION PARK WHICH
PERIODICALLY DISCHARGES SANITARY WASTES.

organic matter from sources indicated as sample point nos. 50, 51, and 52 with 5-day BOD values of 9, 82, and 90 ppm, respectively. Phenols are also high at these locations. Through dilution the levels become generally lower in a downstream direction. The presence of detergents in all of the stream samples indicates that a certain amount of domestic sewage is entering the stream from unknown sources. Total coliform organisms in the tens of thousands at all sampling points indicates intensive bacterial contamination. Faecal coliforms, attributable to human excrement, were also present in quantities ranging to 26,000 per 100 ml, representing a potential health hazard in Redhill Creek. Sample point nos. 47 and 49, located upstream from the refuse disposal site, also show the influence of domestic wastes. This may be caused by faulty tile bed systems in the area.

The heavy pollution carried in the sewage treatment plant discharge accounts for increased levels of 5-day BOD, nutrients and total coliforms as recorded at the monitoring station (no.38) below the outfall. At this location bacteriological analyses showed that total coliform counts averaged 27 million organisms per 100 ml in sampling carried out between October, 1966 and September 1967. It is expected that the construction of secondary sewage treatment facilities will reduce these values to more acceptable levels.

CONCLUSIONS

Pollution from industrial and domestic sources is being discharged in significant quantities through the City of Hamilton storm sewer system into Hamilton Bay and tributary streams. In addition, pollutants are gaining access to receiving streams from the municipal refuse disposal sites.

RECOMMENDATIONS

The City of Hamilton should investigate the sewage and storm sewer collection systems to establish a programme which will reduce to acceptable levels the amounts of pollutants presently gaining access to Hamilton Bay and tributary streams.

The City of Hamilton should continue to investigate means by which water pollution caused by the refuse disposal areas can be eliminated.

GLVF/bv

ACKNOWLEDGEMENTS

We acknowledge and appreciate the assistance of the staff of the City of Hamilton for their co-operation in this survey.

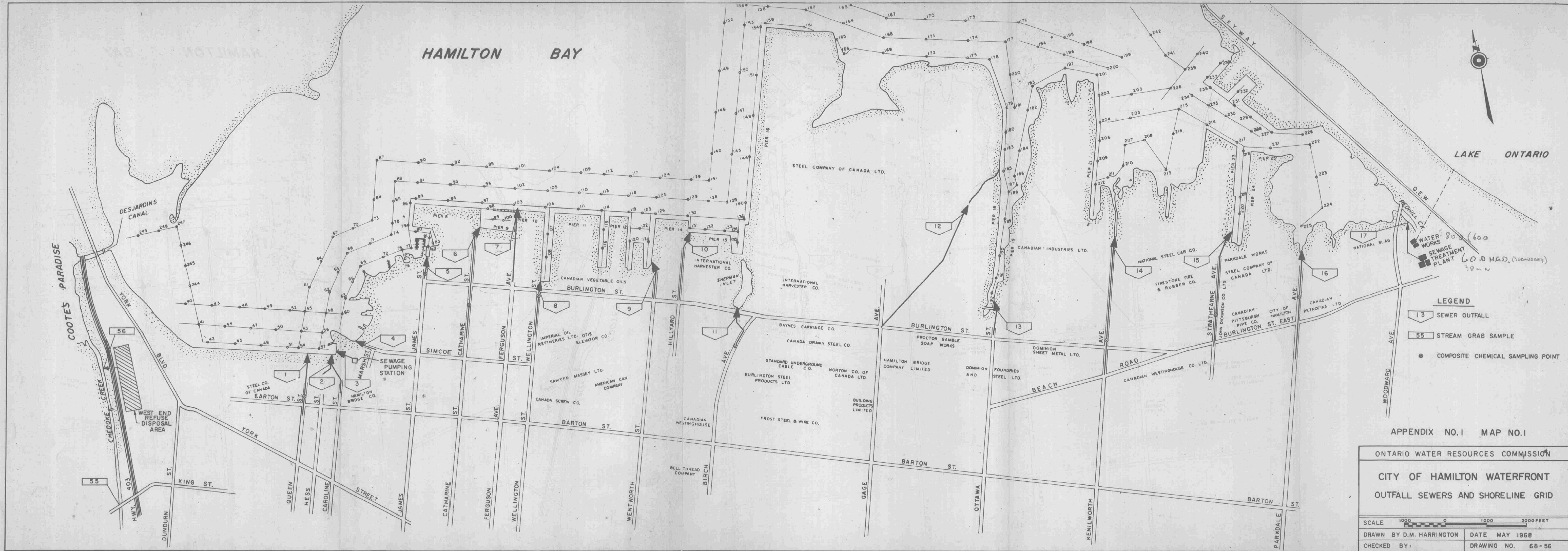
APPENDIX I

CITY OF HAMILTON

MAP No. 1 - CITY OF HAMILTON
WATERFRONT OUTFALL SEWERS
AND SHORELINE GRID

MAP No. 2 - REDHILL CREEK DRAINAGE
BASIN

(SEE MAP POCKET IN BACK COVER)



APPENDIX II

CITY OF HAMILTON

KEY TO SEWER OUTFALLS

AND

OTHER SAMPLING POINTS

LOCATION NO.LOCATIONNOTE: " S " DENOTES SEWER DISCHARGE POINTS

1 S	QUEEN STREET
2 S	HESS & CAROLINE STREETS
3 S	MARCH STREET PUMPING STATION OVERFLOW
4 S	SIMCOE STREET
5 S	JAMES STREET
6 S	CATHARINE STREET
7 S	FERGUSON AVENUE
8 S	WELLINGTON STREET
9 S	WENTWORTH STREET
10 S	HILLYARD STREET
11 S	BIRCH AVENUE
12 S	GAGE AVENUE
13 S	OTTAWA STREET
14 S	KENILWORTH AVENUE
15 S	STRATHEARNE AVENUE
16 S	PARKDALE AVENUE
17 S	SEWAGE TREATMENT PLANT OUTFALL
18 S	BARTON STREET EAST
19 S	BARTON STREET WEST
20 S	QUEENSTON ROAD WEST
21 S	QUEENSTON ROAD EAST
22 S	KING STREET AT LAWRENCE ROAD
23 S	GREENHILL AVENUE
30 S	ROYAL AVENUE
31 S	WEST PARK AVENUE
32 S	STERLING STREET
36 S	WATER WORKS OUTFALL
38	OWRC MONITORING STATION AT MILE 0.10 ON REDHILL CREEK
39	REDHILL CREEK AT BARTON STREET
40	REDHILL CREEK AT QUEENSTON ROAD
41	REDHILL CREEK AT KING STREET
42	OWRC MONITORING STATION AT MILE 4.20 ON REDHILL CREEK
43	REDHILL CREEK AT ALBION ROAD
44	REDHILL CREEK JUST WEST OF C.N.R.
45	REDHILL CREEK NORTH-EAST EDGE OF REFUSE SITE
46	REDHILL CREEK - NORTH SIDE OF REFUSE SITE 50' UPSTREAM OF DUMP DRAIN
47	REDHILL CREEK AT UPPER OTTAWA STREET
48	SMALL TRIBUTARY WEST OF REFUSE SITE
49	ALBION CREEK AT STONE CHURCH ROAD
50	DRAINAGE DITCH AT EAST END OF REFUSE SITE
51	DRAINAGE DITCH AT NORTH SIDE OF REFUSE SITE
52	SULPHUR SPRING INSIDE REFUSE SITE
53	DRAIN OUTLET TO ANCASTER CREEK AT HWY. 8
54	ANCASTER CREEK AT HWY. 8 UPSTREAM FROM DRAIN
55	HWY. 403 DIVERSION CHANNEL NORTH SIDE OF KING STREET
56	DRAIN OUTLET AT WEST END DUMP
57	EAST SIDE DRAINAGE DITCH BACK OF WESTINGHOUSE AT HWY. 403
58	CHEDOKE CREEK AND DIVERSION INLET SOUTH SIDE
59 S	WARD AVENUE SEWER AT CANADIAN ANILINE LIMITED

APPENDIX III - PART ACITY OF HAMILTONPART A - CHEMICAL ANALYSES

- WATERFRONT (NOS. 1, 5, 6, 8, 11, 14, 15, 16)
- ANCASTER CREEK (NOS. 53 & 54)
- CHEDOKE CREEK (NOS. 55 - 59 INCL.)

NOTE: ALL ANALYSES EXCEPT PH REPORTED IN PPM UNLESS OTHERWISE INDICATED.

LOCATION NO.	DATE (1967)	5-DAY BOD	SUSP. SOLIDS	PHENOLS IN PPB	IRON AS FE	PH AT LAB	ANIONIC DETERGENTS AS ABS	CHROMIUM AS CR	ZINC AS ZN	COPPER AS CU	NICKEL AS NI	LEAD AS PB	CADMIUM AS CD	CYANIDE AS HCN
<u>WATERFRONT</u>														
1	AUG. 30	22	128	60	16.3	6.8	1.52	0.08	---	0.06	---	0.17	---	0.00
5	AUG. 30	132	2056	20	11.7	6.7	2.90	0.14	---	0.06	---	0.60	---	0.00
6	AUG. 30	90	830	30	40.5	7.2	3.10	0.20	---	0.16	---	0.60	---	0.03
8	AUG. 30	53	228	60	9.00	7.2	8.00	0.10	---	0.18	---	0.17	---	0.00
11	AUG. 30	37	142	15	11.6	6.8	---	0.72	0.12	---	0.11	0.17	0.01	0.01
14	AUG. 30	61	134	10	1.6	7.2	---	0.04	0.25	0.05	0.00	0.11	0.00	0.00
15	AUG. 30	64	88	10	2.75	7.4	---	IRON INTF.	0.21	0.02	0.27	0.00	0.00	0.03
16	AUG. 30	8.8	176	20	42.3	3.5	---	3.40	46.0	0.32	0.21	0.27	0.50	3.30
<u>ANCASTER CREEK</u>														
53	AUG. 31	53	50	30	---	7.5	---	0.00	---	---	---	0.10	---	0.00
54	AUG. 31	2.3	33	0	---	---	---	---	---	---	---	---	---	0.00
<u>CHEDOKE CREEK</u>														
55	AUG. 31	12	25	60	---	---	---	---	---	---	---	---	---	0.06
56	SEPT. 8	100	76	15	---	---	---	---	---	---	---	---	---	---
57	AUG. 31	12	558	8	---	3.5	0.60	1.6	---	---	---	0.05	---	0.00
58	AUG. 31	0.7	---	3	---	---	---	---	---	---	---	---	---	0.00
59	AUG. 31	322	14	30,000	---	4.0	---	0.0	---	---	---	0.10	---	0.00

APPENDIX III - PART BCITY OF HAMILTONPART B - CHEMICAL AND BACTERIOLOGICAL ANALYSES

- REDHILL CREEK (NOS. 17 - 52 INCL.)

NOTE: 1. ALL ANALYSES EXCEPT PH REPORTED IN PPM UNLESS OTHERWISE INDICATED.

2. * DENOTES THAT SAMPLE DATA HAS BEEN AVERAGED

LOCATION NO.	DATE (1967)	5-DAY BOD	SUSP. SOLIDS	SOLUBLE PHOSPHOROUS	ANIONIC DETERGENTS As ABS	IRON As Fe	NITROGEN As N				PHENOLS IN PPB	TOTAL COLIFORMS 100 ML.	FAECAL COLIFORMS 100 ML.
							TOTAL KJELDAHL	FREE AMMONIA	NITRATE	NITRITE			
REDHILL CREEK													
* 17	AUG. 30	49.0	59	---	---	---	---	---	---	---	---	---	---
18	AUG. 30	6.4	15	---	0.8	---	---	---	---	---	---	---	---
19	AUG. 30	23.0	58	---	0.7	---	---	---	---	---	---	---	---
20	AUG. 30	10.0	24	---	3.2	---	---	---	---	---	---	---	---
21	AUG. 30	13.0	14	---	1.0	---	---	---	---	---	---	---	---
22	AUG. 30	80.0	238	---	4.6	---	---	---	---	---	---	---	---
* 38	OCT./66- SEPT./67	26.7	40.5	2.09	---	2.40	9.06	4.26	0.69	0.06	---	27 MIL.	---
39	AUG. 30	6.1	34	---	0.4	---	---	---	---	---	---	---	---
40	AUG. 30	2.0	4	---	0.2	---	---	---	---	---	---	---	---
41	AUG. 30	4.9	6	---	0.3	---	---	---	---	---	---	---	---
* 42	AUG./66- JULY/67	1.16	18.6	0.07	---	0.45	2.87	0.20	0.05	0.02	---	2104	---
43	DEC. 12	7.0	64	0.33	0.6	3.36	---	1.31	2.00	---	8	88,000	3,900
44	DEC. 12	3.0	68	0.26	0.5	---	6.6	---	1.00	---	10	85,000	1,900
45	DEC. 12	3.0	---	0.31	0.2	---	1.8	0.33	1.00	---	10	56,000	11,000
46	DEC. 12	3.0	80	0.30	0.1	1.72	1.4	0.25	1.00	---	6	47,000	800
47	DEC. 12	2.0	15	---	0.2	---	---	---	0.40	---	3	51,000	1,600
48	DEC. 12	2.0	23	0.21	0.1	1.16	0.58	0.16	0.50	---	10	17,000	7,000
49	DEC. 12	8.0	66	0.50	0.1	4.53	8.3	1.64	2.50	---	6	82,000	26,000
50	DEC. 12	9.0	110	0.12	0.6	6.00	1.7	0.08	3.75	---	150	60,000	68 8
51	DEC. 12	82.0	74	0.02	0.2	4.10	---	0.82	1.00	---	100	63,000	160
52	DEC. 12	90.0	110	0.05	0.4	3.05	18.0	5.74	0.10	---	1250	700,000	22,000

APPENDIX IV

CITY OF HAMILTON

FIELD OBSERVATIONS AND WATER QUALITY DATA

ON HAMILTON BAY



NEAR

WATERFRONT OUTFALLS

AUGUST 26 - SEPTEMBER 18, 1967

The industrial and municipal expansion in the City of Hamilton have created localized water quality management problems. Water quality data and field observations collected in 1967 are presented to illustrate waste dispersion, water quality recovery and organic waste settling in the nearshore harbour areas adjacent to municipal outfalls. A survey grid was established along the industrialized southern shore of the harbour (Appendix No. 1, Map No. 1). Generally, this grid covered an area extending 100 to 1,000 feet offshore. Water quality parameters were measured at selected locations on the grid and adjacent to the outfall within the waste stream if the discharge plume could be detected. The major parameters considered were biochemical oxygen demand, total and soluble phosphate as PO_4 , oxygen, coliform, conductivity, ammonia, turbidity and volatile content of sediment samples. Water quality parameters were determined at 1.5 meters above and below the bottom and surface respectively.

No. 1 - Queen St.

There was no visible sewage flow from the outfall. The water, however, appeared turbid. Bacteriological and chemical results indicated significant sanitary waste contamination was originating from this outfall. Total membrane filter coliform counts adjacent to and 40 feet from the outfall were in excess of 500,000 per 100 ml. This contamination appeared to be localized because total coliform counts at adjacent stations numbered 54, 57 and 53 were below 1,600 per 100 ml. Contamination was further indicated by total phosphate and nitrate concentrations adjacent to and 40 feet from the outfall being 0.5 ppm and 1 ppm. On the 1,000 foot offshore survey grid line, total phosphate and nitrate concentrations (stations 52 and 55) were comparably lower at 0.3 and 0.6 ppm. Chemical oxygen demand adjacent to the outfall was 54 ppm and tapered off to 23 ppm at 40 feet, indicating discharge of organic compounds. The dissolved oxygen per cent saturation was about 90% both adjacent and 40 feet from the outfall. Stations 54 and 57 were two adjacent stations having supersaturated dissolved oxygen levels. The per cent volatiles of sediments at the 40 foot point and at the three adjacent locations were below 11%.

No. 2 - Hess St. and Caroline St.

The discharge area had a strong petroleum odour, and small patches of oil were observed on the water surface. The bottom dredge samples contained an oily substance. Additional oil slicks were noted after dredging. Bubbles of gas were rising to the surface indicating putrefication in process. The water was turbid and there was substantial visual evidence of faecal wastes accompanied by an obnoxious odour near the outfall.

Faecal contamination was indicated by total membrane filter coliform counts adjacent to and 40 feet from the outfall being in excess of 500,000 per 100 ml. Gross sanitary waste build-up on the bottom was not indicated by the values of 13% and 4% for volatile material in the bottom dredge samples adjacent to and at 40 feet from the pipe outlet. Turbidity values were high at 28 and 38 units respectively, when compared to an average turbidity value of 12 units 1,000 feet offshore at stations 55 and 52. The per cent oxygen saturation (75%) was lower than that found at the Queen Street outfall. One thousand feet offshore, the oxygen level was at 90% saturation.

No. 4 - Simcoe St.

The outfall could not be visually observed. However, two metal stakes marked the end of the sewer pipe.

Total membrane coliforms were in excess of 5,000,000 per 100 ml at the stakes, and 970,000 per 100 ml at 25 feet distance. These values indicated gross faecal contamination. Significant discharges of domestic wastes were further indicated by total phosphate values in excess of 1.0 ppm and 0.5 ppm adjacent to, and at 25 feet from the outfall. Nitrate and ammonia concentrations averaged 1.0 ppm and 0.69 ppm respectively. Biochemical oxygen demands of 9 ppm adjacent to, and 4 ppm at 25 feet testify to the uptake of oxygen by organic pollutants. Furthermore, chemical oxygen demand values were 39 ppm adjacent to, and 23 ppm at 25 feet from the outfall.

No. 5 - James St.

Faecal wastes were observed adjacent to the outfall, although the bottom dredge sample contained cinder-like matter. However, the survey boat churned up some excrement, paper and waste material as it left the area. No sewage flow was observed at the outfall site.

Bacteriological and chemical results indicated sanitary waste contamination originated from this outfall. The total membrane filter coliform count adjacent to the outfall was 190,000 per 100 ml and at 40 feet was 2,240,000 per 100 ml. Nitrates on the whole were high at the two outfall sampling locations (around 1.0 ppm) but lower at the three adjacent stations (82, 81 and 80) by a factor of five. Ammonia levels were just over 0.8 ppm at the outfall locations. The per cent saturation of dissolved oxygen at the two outfall sampling locations averaged 80%. Surface dissolved oxygen was above saturation at the three adjacent stations. Per cent saturation near the bottom was, however, down to around 40%. Chemical oxygen demand values at the outfall were 28 ppm and 19 ppm at station 81.

No. 6 - Catherine St.

Sanitary waste contamination originating from this outfall was indicated by the bacteriological and chemical results. Surface total membrane coliform counts were 1,500,000 and 50,000 per 100 ml adjacent to and at 25 feet from the outfall. Bottom coliform counts were lower. Percentage volatile material of the bottom dredge samples averaged 7% over the five locations. Dissolved oxygen per cent saturation was 70% at both sampling locations. However, bottom per cent dissolved oxygen saturation at station 99 was only 8% and at station 98 was only 27% which indicated vigorous biological and/or chemical activity was depleting dissolved oxygen. Turbidity values were 13 units near the outfall sampling points and 8-12 units at stations 99 and 100 and 4-6 units at stations 97 and 98. Total phosphates at the outfall sampling points averaged 0.32 ppm and decreased in the other adjacent locations to 0.2 ppm. Nitrates of 1 ppm were found both at the outfall sampling points, stations 99 and 100 and 0.06 ppm at Stations 97 and 98. Ammonia values were 1 ppm at the outfall sampling points, and stations 99 and 100, and decreased to 0.8 ppm at stations 97 and 98.

No. 7 - Ferguson St.

The outfall was not visible thus its location had to be estimated. A bottom dredge sample, taken at the estimated location had an odour of sanitary sewage. Faecal contamination was indicated by the near surface total membrane filter coliform counts adjacent to, and 10 feet from the outfall of 300,000 and 90,000 per 100 ml respectively, while station 102 had a coliform level of 2,000 per 100 ml. The volatile content of the bottom sediments was 54%. This would indicate a high rate of sedimentation of organic matter in this area. Nitrate levels were 1 ppm and turbidity was 12 units. This compared with lower average values on the 500 foot and 1,000 foot survey grid line (stations 101 and 102) of 0.4 ppm nitrate and 2 units turbidity. Chemical oxygen demand values averaged 22 ppm adjacent to the outfall and decreased to 12 ppm at station 103.

No. 8 - Wellington St.

The water in the slip adjacent to the Wellington Street outfall was extremely turbid containing floating excrement, toilet tissue and other waste material. This pollution was accompanied by gas production within seventy-five feet of the outfall, characteristic of active anaerobic decomposition. Sanitary wastes were being discharged during the study.

Bacteriological and chemical results indicated heavy sanitary waste and faecal contamination originated from this outfall. Total membrane filter coliform counts were 5,000,000 per 100 ml adjacent to the outfall and were greater than 50,000 per 100 ml at the other stations in the slip. The surface coliform membrane filter count at station 106 was 3,400 per 100 ml. Dissolved oxygen saturation values in the entire slip were low. The average was 11% at the outfall sampling points. At the adjacent stations, numbered 108, 107 and 106, the surface oxygen values were 40%, 44% and 80% respectively indicating some recovery. However, the bottom oxygen content at these stations remained low (10%). Notable improvement in water quality was noted from the outfall to station 106. Total phosphate values ranged from 12.3 ppm adjacent to the outfall and to 0.17 ppm at station 106. Phenolic values dropped from 10 ppb adjacent to the outfall to 3 ppb at station 106. Similarly, turbidity values ranged from 64 ppm to 12 ppm, conductivity ranged from 606

No. 8 - Cont'd

to 485 u mhos/cm, chlorides ranged from 68 to 46 ppm and ammonia ranged from 3.78 to 0.99 ppm between the outfall and station 106 respectively. As would be anticipated, the nitrates increased; concentrations of 0.04 ppm adjacent to the outfall increased to 0.96 ppm at station 106 indicating oxidation of waste materials. At the outfall sampling points, the biochemical oxygen demand values were high, ranging from 35 to 17 ppm compared with a value of 2 ppm at station 106. Accumulations of sanitary wastes at the bottom were indicated by the sediment volatile contents of 32%, 27% and 14% adjacent to 40 feet and 125 feet from the outfall. Chemical oxygen demand values were 82 and 54 ppm at 40 feet and 125 feet respectively from the outfall. These compared with an average value of 14 ppm for stations 108 and 107.

No. 9 - Wentworth St.

This outfall was blocked by a berthed ship during the survey. The exact location of the box culvert could thus not be determined.

A resume of water quality parameters at station 121 indicated the presence of faecal contamination. This outfall is the only known discharge location from the municipal collection system west of Pier 14. Faecal contamination was indicated by total membrane filter coliforms being in excess of 50,000 per 100 ml. Nitrates and ammonia were each 1 ppm and turbidity was 11 units. These results compared with the lower values at station 125 of 4,200 per 100 ml for coliforms, 0.4 ppm for nitrates and 0.8 ppm for ammonia. Dissolved oxygen saturation was 74%. The volatile content of the dredge sample was 7% at station 121.

No. 10 - Hillyard St.

Small patches of scum were observed near the piers. A strong odour characteristic of sulfur dioxide was also present. Furthermore, bottom dredge samples showed signs of sanitary wastes. Oil slicks appeared after the bottom was disturbed. No outfall plume was evident.

Bacteriological and chemical results pointed to sanitary waste and faecal contamination originating from the outfall. Total membrane filter coliform counts were 72,000 and 140,000 per 100 ml on the surface adjacent to, and at 25 feet from the outfall respectively. The coliform count at station 131 was 81,000 per 100 ml. Counts at stations 130 and 132 were in excess of 150,000 per 100 ml. Nitrate values were high at the outfall sampling points (1.9 and 1.1 ppm) and decreased to an average 0.8 ppm at stations 131, 130 and 132. Ammonia values were 1.51 ppm adjacent to and 1.90 ppm at 25 feet from the outfall. The turbidity was 14 units 500 feet offshore. At station 129, however, the turbidity had decreased to 4 units. Settling of sanitary wastes was indicated adjacent to and at 25 feet from the outfall by the sediment volatile contents of 38% and 32% respectively. Chemical oxygen demands of 39 and 28 ppm were noted adjacent to and 25 feet from the outfall.

No. 11 - Birch Ave.

The municipal sewer and the International Harvester Company outfall discharge into Sherman Inlet. Sampling results, therefore, reflect the effect of discharges from both outfalls. Patches of oil were visible in slip 15. An oil skimmer at the bridge across Sherman Inlet prevented more oil from entering the harbour.

Faecal contamination was indicated by coliform counts in excess of 5,000,000 per 100 ml at the bridge and 2,200,000 per 100 ml 25 feet from the bridge. Total counts at stations 135 and 134 were in excess of 50,000 coliforms per 100 ml. The dissolved oxygen per cent saturation 25 feet from the bridge and at stations 135 and 134 was 60%. The total phosphate level was 1 ppm at the bridge and 0.3 ppm at station 134. Nitrate values averaged 0.82 ppm at the bridge and were reduced to 0.60 ppm at station 139, about 1,000 feet from the outfall. Ammonia concentrations adjacent to and 25 feet from the bridge were 2.3 and 1.2 ppm respectively, and 1 ppm in the slip. The turbidity value decreased from 11 units at the bridge to 4 units at station 139. Chemical oxygen demand values of 16 and 26 ppm were measured adjacent to and 25 feet from the bridge; values in excess of 54 ppm were measured at stations in the slip. The total volatile content of the dredged sample collected at station 135 was 16%.

No. 12 - Gage Ave.

A municipal sewer and an outfall from the Dominion Foundry and Steel Limited plant discharge to a small ditch which ultimately drains into the Ottawa Street slip. The ditch contained rust coloured water with floating sanitary solids. Oil patches were present below the point of discharge into Hamilton Harbour; however, no plume or flow was apparent.

Bacteriological results indicated that faecal contamination was originating from the spent waters discharged to the harbour. Total membrane filter coliforms counts adjacent to the ditch mouth were 410,000 per 100 ml; however, a count of 2,100 per 100 ml was recorded for station 185. Chemical results further supported the evidence that sanitary wastes originated from the ditch outfall. In the ditch water, the total phosphate level was 2 ppm, ammonia 16 ppm, turbidity 130 units and conductivity 712 u mhos/cm. These values were lower at station 185, with total phosphate being 0.28 ppm, ammonia 1.97 ppm, turbidity 6 units and conductivity 526 u mhos/cm. The biochemical oxygen demand was 21 ppm adjacent to the ditch outfall and 2 ppm at station 185. The dissolved oxygen level adjacent to the ditch outfall was zero and increased to 50 per cent saturation at station 185. Concentrations decreased from the ditch outfall to station 185 for chemical oxygen demand - 88 to 23 ppm and phenols - 40 to 6 ppb. The value for iron at station 185 was 4.5 ppm. Ac-

No. 12 -- Cont'd

cumulation of sediments originating from sanitary wastes was not indicated since the total volatiles content of a dredge sample adjacent to the outfall was 1%.

No. 13 - Ottawa St.

The municipal outfall discharged at the head of the Ottawa Street slip. Water at this location had a black appearance and contained fine suspended matter. Oil slicks were also evident in patches and may have resulted from spillage at the skimmer located at the Dofasco outfall. Samples were collected adjacent to the municipal outfall and at station 191. The effluent appeared to be in part cooling water, as the temperature recorded at the outfall was 33°C.

The total membrane filter coliform count adjacent to the outfall of 250,000 per 100 ml indicated the presence of domestic sewage. In comparison, the coliform density at station 191 was 1,900 per 100 ml. A total phosphate concentration of 1 ppm was noted at the outfall and 0.38 ppm at station 191. Organic waste settling was indicated by per cent volatiles of bottom dredge samples being 20% and 29% adjacent to the outfall and at station 191 respectively. Industrial pollution was evident from the results at station 191. Phenols and iron values were 10 ppb and 8.3 ppm.

No. 14 - Kenilworth St.

This outfall discharges to Oggs Inlet. Waste materials originating from raw sewage were noted along the banks of the inlet in the vicinity of the outfall, however, no flow was evident. The release of gas accompanied by an objectionable odour was distinct along the entire length of the inlet.

Total membrane filter coliform counts in excess of 5,000,000 per 100 ml were noted adjacent to the outfall thus indicating gross faecal contamination. Coliform counts of 40,000 per 100 ml and 5,100 per 100 ml were noted at station 211 at the surface and bottom respectively. The chemical analyses also indicated gross pollution by sanitary wastes. A biochemical oxygen demand of 39 ppm and an absence of oxygen was noted adjacent to the outfall. At station 211, biochemical oxygen demand was 4 ppm and the oxygen was at 95% saturation at the surface and 60% near the bottom. The nutrient levels were high at the outfall with values of 12.5 ppm for total phosphates and 29.5 ppm for ammonia. These levels decreased to an average of 0.32 ppm and 0.17 ppm at station 211. The conductivity at the outfall was 634 u mhos/cm and the alkalinity was 192 ppm. These values reduced to 523 u mhos/cm and 82 ppm at station 211. Surface and bottom values for iron at station 211 were 2 ppm and 6.3 ppm respectively. Twelve hundred feet further out, a value of 1.35 ppm was measured for total iron at station 208.

No. 15 - Stratherne Ave.

A yellow oily scum about six inches in depth, containing sanitary wastes and other floating debris was observed within 30 feet of the outfall and throughout the entire width of the slip at Pier 23. Dissolved oxygen values were found to be low and gas continually bubbled to the surface. There was only a small flow from the outfall during the study.

Extreme faecal contamination originating from the outfall was indicated by total membrane filter coliform counts in excess of 5,000,000 per 100 ml adjacent to the outfall. The count was reduced to 100,000 per 100 ml at station 218. Further evidence of pollution was indicated by the surface (T) and bottom (B) values adjacent to the outfall of the following parameters: total phosphates - 4.3 ppm (T) and 6.8 ppm (B), turbidity - 70 units (T) and 31 units (B), conductivity - 612 u mhos/cm (T) and 675 u mhos/cm (B) and ammonia - 5.25 ppm (T) and 8.2 ppm (B). Comparable values at station 218 were lower with total phosphates - 0.64 ppm (T) and 0.4 ppm (B), turbidity - 4 units (T) and 7 units (B), conductivity - 548 u mhos/cm (T) and 510 u mhos/cm (B) and ammonia - 378 ppm (T) and 0.65 ppm (B). The surface alkalinity at the outfall was 208 ppm. The alkalinity at the nearby station 219 was 80 ppm.

No. 15 - Cont'd

Dissolved oxygen saturation values at the outfall were low (9%) throughout the full depth. In comparison the water at station 120 was supersaturated with oxygen at 121%. At stations 219 and 218, values of 93% (T) and 10% (B) and 108% (T), 49% (B) respectively were noted. Biochemical oxygen demand values adjacent to the outfall were 62 ppm (T) and 24 ppm (B). An average value of 8 ppm was noted at station 219. The bottom value for chemical oxygen demand was 98 ppm adjacent to the outfall. This was reduced to 16 ppm (B) at station 220. Iron values for station 220 were 1.8 ppm and 4.4 ppm for surface and bottom concentrations.

No. 16 - Parkdale Ave.

The Cabot Carbon Company discharges wastes to a ditch flowing into Hamilton Harbour. There was noticeable sanitary wastes and floating excrement in the area. The outfall was initially sampled where it flowed into Hamilton Harbour. The bottom dredge sample was a sticky amber coloured mass, having a petroleum odour.

Bacteriological results pointed out that domestic wastes were originating from this outfall. The total membrane filter coliform count adjacent to the ditch outfall was 300,000 per 100 ml. At station 222, this value decreased to 97,000 per 100 ml. Chemical results also indicated that sanitary wastes were originating from the outfall. Comparative quality adjacent to the ditch outfall and station 222 are as follows: total phosphate - 13.5 ppm and 2.0 ppm, nitrate - 0.52 ppm and 0.2 ppm, ammonia - 2.62 ppm and 1.47 ppm, conductivity - 606 u mhos/cm and 581 u mhos/cm and phenols - 10 ppb and 0 ppb.